WHAT IS CLAIMED IS:

1. A method of calculating a prediction distance from a reference object to a target after predetermined constant time from a current state that the reference object and the target have a positional relationship therebetween, said method comprising:

frequency-modulating a radar wave signal within a predetermined frequency modulation range from bottom to top so that a frequency of the frequency-modulated radar wave changes in time, a rate of frequency change of said radar wave signal in time being set to F0/Tf, said F0 representing a center frequency in the frequency modulation range, said Tf representing the predetermined constant time;

mixing the frequency-modulated radar wave signal transmitted from the reference object and a reflection signal to obtain a beat signal, said reflection signal being based on the transmitted radar wave signal reflected from the target, said beat signal being based on a frequency difference between a frequency of the transmitted radar wave signal and that of the reflection signal;

sweeping the beat signal within the frequency modulation range from one of the bottom and the top to the other thereof to obtain a frequency component of the beat signal; and

obtaining the prediction distance based on a relationship between the frequency component of the beat signal and the prediction distance.

2. The method according to claim 1, wherein said relationship between the frequency component of the beat signal and the prediction

distance is represented as an equation:

$$fb = \frac{2K}{C} \bullet Rp$$

where the Rp represents the prediction distance, the fb represents the frequency component of the beat signal, and the C represents the velocity of light.

3. The method according to claim 1, wherein said sweeping step sweeps the beat signal within the frequency modulation range from one of the bottom and the top to the other thereof every predetermined period to obtain the frequency component of the beat signal every predetermined period, and wherein said obtaining step of the prediction distance obtains the prediction distance based on the relationship between the frequency component of the beat signal and the prediction distance every predetermined period, further comprising calculating a relative velocity between the reference object and the target according to the prediction distances, said prediction distances being obtained in adjacent predetermined periods, respectively.

4. The method according to claim 3, further comprising:

calculating a prediction frequency component in the current predetermined period according to the prediction distance obtained in the previous predetermined period and the relative velocity calculated in the previous predetermined period; and

comparing the calculated prediction frequency component in the current predetermined period with the obtained frequency component

therein to determine whether the relationship between the previous frequency component obtained in the previous predetermined period and the current frequency component obtained in the current predetermined period has continuity according to the compared result.

5. The method according to claim 1, wherein said reference object is a vehicle in which a collision avoidance unit and a collision damage reducing unit are installed, further comprising:

determining whether the vehicle will collide with the target according to the prediction distance;

when determining that the vehicle will collide with the target according to the prediction distance, operating the collision avoidance unit to avoid the collision of the vehicle with the target; and

when determining that the collision of the vehicle with the target is unavoidable, operating the collision damage reducing unit to reduce the damage of collision.

6. The method according to claim 3, wherein said reference object is a vehicle, further comprising:

storing thereon information related to a dead zone and a collision zone, said dead zone being a frequency band of the beat signal in which it is difficult to detect the frequency component due to a low frequency noise component included in the frequency band, said collision zone being defined by a predetermined distance between the vehicle and the target and a predetermined relative velocity therebetween and causing a collision between the vehicle and the target to be unavoidable; and

determining whether the vehicle has already been positioned in the dead zone or the collision zone according to the stored information, the obtained frequency component and the calculated relative velocity between the reference object and the target.

7. A method of calculating a current distance from a reference object to a target, and a prediction distance from the reference object to the target after predetermined constant time from a current state that the reference object and the target have the current distance, said method comprising:

first frequency-modulating a first radar wave signal so that a frequency of the frequency-modulated first radar wave alternately increases and decreases in time;

first mixing the frequency-modulated first radar wave signal transmitted from the reference object and a first reflection signal to obtain a first beat signal, said first reflection signal being based on the transmitted first radar wave signal reflected from the target, said first beat signal being based on a frequency difference between a frequency of the transmitted first radar wave signal and that of the first reflection signal;

first sweeping the first beat signal within a rising modulation period in which the frequency of the first radar signal increases and within a falling modulation period in which the frequency thereof decreases, respectively, to obtain a pair of frequency components of the first beat signal corresponding to each of the rising modulation period and the falling modulation period;

first obtaining the current distance based on the pair of frequency

components of the beat signal;

second frequency-modulating a second radar wave signal within a predetermined frequency modulation range from bottom to top so that a frequency of the frequency-modulated second radar wave changes in time, a rate of frequency change of said second radar wave signal in time being set to F0/Tf, said F0 representing a center frequency in the frequency modulation range, said Tf representing the predetermined constant time;

second mixing the frequency-modulated second radar wave signal transmitted from the reference object and a second reflection signal to obtain a second beat signal, said second reflection signal being based on the transmitted second radar wave signal reflected from the target, said second beat signal being based on a frequency difference between a frequency of the transmitted second radar wave signal and that of the second reflection signal;

second sweeping the second beat signal within the frequency modulation range from one of the bottom and the top to the other thereof to obtain a frequency component of the second beat signal; and

second obtaining the prediction distance based on a relationship between the frequency component of the second beat signal and the prediction distance.

8. The method according to claim 6, wherein said first sweeping step sweeps the first beat signal within the rising modulation period and the falling modulation period every first predetermined period to obtain the pair of frequency components of the first beat signal every predetermined period, said first obtaining step obtains the current

distance based on the pair of frequency components of the first beat signal every first predetermined period, said second sweeping step sweeps the second beat signal within the frequency modulation range from one of the bottom and the top to the other thereof every second predetermined period to obtain the frequency component of the second beat signal every second predetermined period, and wherein said second obtaining step obtains the prediction distance based on the relationship between the frequency component of the second beat signal and the prediction distance every second predetermined period, each of said second predetermined period being included within each of said first predetermined period.

9. A system for calculating a prediction distance from the own system to a target after predetermined constant time from a current state that the reference object and the target have a positional relationship therebetween, said system comprising:

a frequency-modulating unit configured to frequency-modulate a radar wave signal within a predetermined frequency modulation range from bottom to top so that a frequency of the frequency-modulated radar wave changes in time, a rate of frequency change of said radar wave signal in time being set to F0/Tf, said F0 representing a center frequency in the frequency modulation range, said Tf representing the predetermined constant time;

a transmitting unit configured to transmit the frequency-modulated radar wave signal;

a receiving unit configured to receive a reflection signal, said reflection signal being based on the transmitted radar wave signal

reflected from the target;

a mixing unit configured to mix the transmitted frequency-modulated radar wave signal and the reflection signal to obtain a beat signal, said beat signal being based on a frequency difference between a frequency of the transmitted radar wave signal and that of the reflection signal;

a sweeping unit configured to sweep the beat signal within the frequency modulation range from one of the bottom and the top to the other thereof to obtain a frequency component of the beat signal; and

an obtaining unit configured to obtain the prediction distance based on a relationship between the frequency component of the beat signal and the prediction distance.

10. The system according to claim 9, wherein said relationship between the frequency component of the beat signal and the prediction distance is represented as an equation:

$$fb = \frac{2K}{C} \bullet Rp$$

where the Rp represents the prediction distance, the fb represents the frequency component of the beat signal, and the C represents the velocity of light.

11. The system according to claim 9, wherein said sweeping unit is configured to sweep the beat signal within the frequency modulation range from one of the bottom and the top to the other thereof every predetermined period to obtain the frequency component of the beat

signal every predetermined period, and wherein said obtaining unit is configured to obtain the prediction distance based on the relationship between the frequency component of the beat signal and the prediction distance every predetermined period, further comprising a first calculating unit configured to calculate a relative velocity between the own system and the target according to the prediction distances, said prediction distances being obtained in adjacent predetermined periods, respectively.

12. The system according to claim 11, further comprising:

a second calculating unit configured to calculate a prediction frequency component in the current predetermined period according to the prediction distance obtained in the previous predetermined period and the relative velocity calculated in the previous predetermined period; and

a comparing unit configured to compare the calculated prediction frequency component in the current predetermined period with the obtained frequency component therein to determine whether the relationship between the previous frequency component obtained in the previous predetermined period and the current frequency component obtained in the current predetermined period has continuity according to the compared result.

13. The system according to claim 9, wherein said own system is installed in a vehicle in which a collision avoidance unit and a collision damage reducing unit are installed, further comprising:

a determining unit configured to determine whether the vehicle will collide with the target according to the prediction distance;

when determining that the vehicle will collide with the target according to the prediction distance, a first operating unit configured to operate the collision avoidance unit to avoid the collision of the vehicle with the target; and

when determining that the collision of the vehicle with the target is unavoidable, a second operating unit configured to operate the collision damage reducing unit to reduce the damage of collision.

14. The system according to claim 9, wherein said own system is installed in a vehicle, further comprising:

a storing unit configure to store information related to a dead zone and a collision zone, said dead zone being a frequency band of the beat signal in which it is difficult to detect the frequency component due to a low frequency noise component included in the frequency band, said collision zone being defined by a predetermined distance between the vehicle and the target and a predetermined relative velocity therebetween and causing a collision between the vehicle and the target to be unavoidable; and

a determining unit configured to determine whether the vehicle has already been positioned in the dead zone or the collision zone according to the stored information, the obtained frequency component and the calculated relative velocity between the reference object and the target.

15. A system for calculating a current distance from the own system to a target, and a prediction distance from the own system to the

target after predetermined constant time from a current state that the own system and the target have the current distance, said system comprising:

a first frequency-modulating unit configured to frequency-modulate a first radar wave signal so that a frequency of the frequency-modulated first radar wave alternately increases and decreases in time;

a first transmitting unit configured to transmit the frequency-modulated first radar wave signal;

a first receiving unit configured to receive a first reflection signal, said first reflection signal being based on the transmitted first radar wave signal reflected from the target;

a first mixing unit configured to mix the transmitted frequency-modulated first radar wave signal and the first reflection signal to obtain a first beat signal, said first beat signal being based on a frequency difference between a frequency of the transmitted first radar wave signal and that of the first reflection signal;

a first sweeping unit configured to sweep the first beat signal within a rising modulation period in which the frequency of the first radar signal increases and within a falling modulation period in which the frequency thereof decreases, respectively, to obtain a pair of frequency components of the first beat signal corresponding to each of the rising modulation period and the falling modulation period;

a first obtaining unit configured to obtain the current distance based on the pair of frequency components of the beat signal;

a second frequency-modulating unit configured to frequency-modulate a second radar wave signal within a predetermined

frequency modulation range from bottom to top so that a frequency of the frequency-modulated second radar wave changes in time, a rate of frequency change of said second radar wave signal in time being set to F0/Tf, said F0 representing a center frequency in the frequency modulation range, said Tf representing the predetermined constant time;

a second transmitting unit configured to transmit the frequency-modulated second radar wave signal;

a second receiving unit configured to receive a second reflection signal, said second reflection signal being based on the transmitted second radar wave signal reflected from the target;

a second mixing unit configured to mix the transmitted frequency-modulated second radar wave signal and the second reflection signal to obtain a second beat signal, said second beat signal being based on a frequency difference between a frequency of the transmitted second radar wave signal and that of the second reflection signal;

a second sweeping unit configured to sweep the second beat signal within the frequency modulation range from one of the bottom and the top to the other thereof to obtain a frequency component of the second beat signal; and

a second obtaining unit configured to obtain the prediction distance based on a relationship between the frequency component of the second beat signal and the prediction distance.

16. The system according to claim 15, wherein said first sweeping unit is configured to sweep the first beat signal within the rising modulation period and the falling modulation period every first

predetermined period to obtain the pair of frequency components of the first beat signal every predetermined period, said first obtaining unit is configured to obtain the current distance based on the pair of frequency components of the first beat signal every first predetermined period, said second sweeping unit sweeps the second beat signal within the frequency modulation range from one of the bottom and the top to the other thereof every second predetermined period to obtain the frequency component of the second beat signal every second predetermined period, and wherein said second obtaining unit obtains the prediction distance based on the relationship between the frequency component of the second beat signal and the prediction distance every second predetermined period, each of said second predetermined period being included within each of said first predetermined period.

17. A program product that is readable by a signal processing unit for calculating a prediction distance from a reference object to a target after predetermined constant time from a current state that the reference object and the target have a positional relationship therebetween, in which said signal processing unit is installed in the reference object and is communicable with a frequency-modulating unit installed in the reference object, said program product comprising:

means for causing the signal processing unit to control the frequency-modulating unit so that the frequency-modulating unit frequency-modulates a radar wave signal within a predetermined frequency modulation range from bottom to top so that a frequency of the frequency-modulated radar wave changes in time, a rate of frequency

change of said radar wave signal in time being set to F0/Tf, said F0 representing a center frequency in the frequency modulation range, said Tf representing the predetermined constant time;

when the frequency-modulated radar wave signal transmitted from the reference object and reflected from the target is received as a reflection signal, and the reflection signal is mixed with the transmitted radar wave signal to obtain a beat signal that is based on a frequency difference between a frequency of the transmitted radar wave signal and that of the reflection signal,

means for causing the signal processing unit to sweep the beat signal within the frequency modulation range from one of the bottom and the top to the other thereof to obtain a frequency component of the beat signal; and

means for causing the signal processing unit to obtain the prediction distance based on a relationship between the frequency component of the beat signal and the prediction distance.